CALIFORNIA STATE DEPARTMENT OF PUBLIC HEALTH
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*MALARIA SURVEYS**

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At the present time malaria is endemic in the lower Atlantic Seaboard south of Washington, in the Mississippi Valley, and westward in Texas. There are endemic areas in New Mexico, and in California. Even in these areas it has been controlled so that it is primarily a rural disease.

Since great variations exist in the extent and severity of the malaria problem in different localities, each must be studied as a separate unit. It is therefore impossible as well as impractical to formulate a set program which applies to all geographic areas.

However, in order to determine the need for control work or the results achieved thereby, surveys should be made by an adequately trained personnel. Naturally these investigations must cover both the human and anopheline elements and in general should endeavor to supply answers to the following questions:

1. How many proved cases of malaria have occurred during the year?
2. Has transmission in the most recent season been slight or great?
3. What is the local geographical distribution of malaria?
4. What is the seasonal distribution of malaria?
5. What vectors or transmitting agents are present in the district?
6. What per cent of vectors or transmitting agents are naturally infected?
7. What is the status of housing and protection from mosquitoes?

To obtain the most detailed and valuable data surveys should be conducted over a twelve-month period in a single district. There are four types of surveys used and the results correlated to obtain the maximum information. They are as follows:

1. Mosquito or anopheline survey.
2. Malaria histories.
3. Spleen survey.
4. Parasite or blood smear survey.

Before starting the survey the investigator should supply himself with:

1. A good large scale map of the area under investigation to be used for making spot maps of the various field studies and hence correlating all surveys.
2. The most recent official census data for the area because it is necessary to know approximately the size of the population and whether it is fixed or fluctuating.

The latter is very important in California since there are many migratory residents from malarious districts. Official morbidity statistics of the Cali-

* Read before Annual Meeting of Mosquito Abatement Officials, Berkeley, December 15, 1936.

fornia State Department of Public Health have demonstrated that these transients are a definite source of infection.

The first survey to be considered is the mosquito or anopheline. There are two phases of this program; first, to determine the presence of malaria vectors in a given district, and second, to determine the per cent naturally infected with malaria parasites.

Collections of adult mosquitoes and larvae are made to detect the presence of malaria vectors. Epidemiologically, the study of the occurrence and habits of adults is more important. However, when the feasibility of control work is under discussion then larvae and production areas must be given consideration.

Observations should be made within the population area where malaria incidence is under investigation and also within the radius of a mile surrounding this district.

Pertinent field data should be recorded as follows:

1. Date and hour of collection.
2. Exact description where specimens were obtained.
3. Identification of specimens.
4. Spot maps recording types of vectors found and allocating breeding places.

The second phase of the anopheline survey is to determine for each vector in a malarious region the per cent of naturally infected specimens. The female anophelines are captured alive and kept for 2-3 days for the digestion of the blood meal. The mosquitoes are then dissected and the salivary glands and stomachs removed and examined microscopically for the presence of malarial parasites.

The positives are spotted on the map and compared with the location of human cases reported. These surveys should be conducted in the malaria season and over a period of at least one month.

The second type of survey is malaria histories, which include official vital statistics, both cases and deaths, and individual histories obtained by house to house visits. The official records are of less practical importance for malaria than for any other disease.

It is impossible to make an accurate estimate of the incidence of malaria because of two factors. First, the proportion of all cases of acute malaria seen by physicians is small and reports are often inaccurate. In taking histories on residents during a survey many state that they have had a "touch of malaria" and that they took patent chill tonics. Much of this "traditional malaria" was eliminated after the introduction of typhoid vaccination in the southern states, indicating that the diagnosis of this disease was improperly made.

A second and more important factor is that the physicians do not report the disease well. In two rural counties of California where many cases of malaria were rumored, the official statistics showed only six cases for one county and eight for the other. The physicians were interviewed with the result that records of thirty-three unreported cases were obtained. Again many patients with symptoms resembling malaria visit the doctor only once. The physician prescribes quinine, and if the patient does not return the diagnosis is malaria. This method of diagnosis is too often employed in place of the more accurate method of examination of blood for parasites.

Where the standards of medical practice are high, and physicians sufficiently numerous, it is desirable to increase the accuracy of diagnosis and reporting, and thus diminish the necessity for survey operations. Physicians should therefore be encouraged and required to report individually all cases of malaria encountered in their practice.

Death records, also often give misleading information. In a third rural county of California the number of malaria deaths was abnormally high. Almost all these certificates were signed by one doctor. When attempts were made by the State Department of Public Health to check these deaths by laboratory examinations the results were negative. The number of deaths from malaria dropped abruptly with the death of this physician.

The inadequacy or complete absence of morbidity reports of malaria has led some field workers in the United States to compile statistics based on the personal testimony of the individuals interviewed. This information is usually secured at the end of the fever season.

A house to house canvas is made to obtain the probable history of malaria among the inhabitants and is of real value as an index of the disease in any community if the data are evaluated with discretion. For example, "traditional malaria" must be eliminated.

For each individual a history card is used, giving name, age, sex, color or race, place of residence, occupation and economic status, length of time in immediate environment, history of previous malaria, multiple cases in the household, type of dwelling, presence of mosquitoes, acute illness with date of onset, character of fever, and the results of blood smear examination.

After considering the striking limitations of official records as well as the inadequacy of histories that can be taken concerning malaria prevalence, interest is naturally directed to data of a more positive character, obtained by spleen and parasite surveys. Splenic enlargement is one of the characteristic physical signs of malaria infection. And, apart from its importance to the clinician as a diagnostic sign is of considerable

value to the epidemiologist in judging the incidence of malaria within a region.

As a rule only children under twelve years of age should be examined for the spleen index. During 1926 a survey was made in California including boys from five to thirteen years of age. This group was selected for the following reasons:

1. All the information necessary could be gained from this group.
2. The maximum of infection was reached within these age limits.
3. This group lent itself more easily to abdominal palpation and no differences have been noted in the spleen index between boys and girls of this age.

Random sampling of school children was used in these studies for several reasons.

1. Considerable time was saved in utilizing an assembled group.
2. From the standpoint of stability in residence this group was most fixed, and would probably reflect more accurately the endemic or residual malaria in the community.

Repeated annual examinations are also advocated in districts, especially where the morbidity reports are uncertain. Some investigators claim that spleen examinations are superior to other methods of determining the incidence of malaria particularly in endemic areas.

In the interpretation of spleen rates the recent incidence of the acute diseases of childhood should be considered, since chickenpox, mumps, and measles cause acute enlargement. However, because of the age group used, the rare cases of chronic enlarged spleens may be ruled out.

Districts with consistently low spleen rates (0-10%) are thought to be areas of low endemicity. Moderate or high endemicity does not exceed 50 per cent. The central committee for the study of malaria in India considers areas where the splenic index is below 10 per cent as healthful areas.

The spleen rates are most valuable if taken in the late fall or early winter because they give the residual malaria in a community for the preceding year.

The fourth and last type of survey to be discussed is the parasite or blood smear, and this study should be conducted during the period of maximum transmission, usually in the spring and fall. The highest per cent of positives showing Tertian parasites may be expected in the spring and for aestivo-autumnal parasites in the fall. It is often difficult to conduct the survey at the most advantageous season and therefore the results must be considered accordingly.

In many localities the parasite index is taken of the school children correlating the spleen findings with the blood. This type of survey will give considerable information in a relatively short time. However, a more accurate analysis is made when the sampling includes all age groups, both sexes and represents a cross section of the district under investigation. The procedure becomes a house to house canvass and blood smears are taken wherever the residents are willing. It is difficult to give a set formula for an adequate number to include in a survey. The State Department of Public Health in making a parasite index of a district usually includes both school children and as many of the general population as will submit.

The results that may be expected from the examination of a series of smears collected at random are not comparable to smears taken from febrile cases for diagnosis. In the first place, many are from uninfected individuals or from chronic cases in a latent phase. Secondly, comparatively few will be from individuals experiencing an acute attack, and consequently the positive smears will show but few parasites.

The value and accuracy of the parasite index depends to a great extent on the experience of the microscopist. The index established by the examination of a single series of smears taken from the group constituting the sample will not reveal all, or perhaps even approximately all infected individuals. There will always exist an appreciable margin between the index and the actual but indeterminable rate. Part of this margin may be overcome by increasing the size of the original sample.

History cards should be provided for each person. These histories include the same data as listed above with particular reference to residence. During the past year special attention has been directed to the transient labor groups scattered through the rural agricultural counties. These people have a definite housing problem. They live in unscreened tents for the most part and since they come from malarious districts in the south, may act as a new reservoir of infection for malaria in California. In the fall of this year a parasite survey was conducted in three rural counties in California covering the migratory camps. The results are incomplete at this time.

Four types of survey have been discussed in an effort to present the methods necessary to make an epidemiological diagnosis of the malaria problem in a given district. The correlation of all surveys should provide information that may lead to the establishment of a definite program designed particularly to solve specific local problems in an efficient manner and at a minimum of expense.

MORBIDITY

Complete Reports for Following Diseases for Week Ending January 2, 1937

Chickenpox

357 cases: Alameda County 2, Alameda 3, Albany 1, Berkeley 7, Hayward 1, Livermore 2, Oakland 9, San Leandro 5, Contra Costa County 1, Eldorado County 1, Fresno County 1, Fresno 3, Reedley 1, Los Angeles County 37, Alhambra 2, Compton 1, Culver City 4, El Monte 1, Glendale 2, Huntington Park 2, Inglewood 1, La Verne 9, Long Beach 5, Los Angeles 57, Monrovia 1, Pasadena 20, Pomona 4, San Fernando 1, San Gabriel 3, San Marino 7, Santa Monica 3, Whittier 3, Torrance 1, Lynwood 1, South Gate 2, Gardena 2, San Rafael 14, Merced County 1, Los Banos 1, Carmel 1, Monterey 1, Napa County 2, Orange County 1, Fullerton 1, Santa Ana 5, Roseville 1, Plumas County 1, Sacramento County 1, Sacramento 7, Ontario 7, Redlands 5, Oceanside 1, San Diego 8, San Francisco 29, San Joaquin County 1, Manteca 1, Stockton 1, San Mateo County 3, Burlingame 2, Daly City 1, Redwood City 1, South San Francisco 1, Santa Barbara County 2, Santa Barbara 6, Santa Clara County 1, Palo Alto 12, San Jose 6, Santa Clara 1, Santa Cruz 1, Healdsburg 3, Santa Rosa 1, Oakdale 2, Tulare County 2, Lindsay 5, Yolo County 2, Winters 2, Marysville 1, Riverside County 2, Beaumont 1, Riverside 3.

Diphtheria

66 cases: Alameda County 1, Oakland 1, Butte County 1, Kern County 1, Bakersfield 1, Kings County 2, Los Angeles County 5, El Monte 2, Los Angeles 20, Pasadena 1, Orange County 4, Sacramento 2, San Diego 6, San Francisco 1, Stockton 1, Santa Clara County 1, San Jose 2, Stanislaus County 2, Turlock 3, Ventura County 8, Ventura 1.

German Measles

25 cases: Oakland 1, Humboldt County 11, Eureka 3, Los Angeles County 1, Glendale 1, Long Beach 1, Los Angeles 3, Anaheim 1, San Francisco 2, Vallejo 1.

Influenza

54 cases: Berkeley 1, Oakland 1, Los Angeles County 5, Los Angeles 28, Monterey Park 1, Santa Ana 4, Sacramento 1, San Diego 1, San Francisco 3, Siskiyou County 9.

Malaria

One case: Burbank.

Measles

48 cases: Alameda 1, Los Angeles County 1, Alhambra 1, Long Beach 3, Los Angeles 10, Redondo 1, Pacific Grove 1, Napa County 1, Nevada County 2, Santa Ana 1, Placer County 1, Roseville 10, Riverside County 1, Riverside 1, San Diego County 1, El Cajon 2, San Francisco 2, Santa Barbara 2, Palo Alto 1, Vallejo 3, Tulare County 1, Ventura 1.

Mumps

353 cases: Alameda County 1, Alameda 5, Berkeley 8, Livermore 2, Oakland 4, Placerville 2, Fresno County 1, Fresno 1, Eureka 23, Kern County 3, Los Angeles County 34, Alhambra 1, Burbank 3, Compton 10, Culver City 3, El Monte 1, Glendale 1, Huntington Park 11, Inglewood 1, Long Beach 1, Los Angeles 41, Pasadena 9, Redondo 1, San Marino 1, Santa Monica 2, Whittier 1, Torrance 2, Lynwood 2, South Gate 2, Madera 1, Merced County 4, Los Banos 6, Napa County 1, Orange County 5, Anaheim 1, Brea 3, Santa Ana 9, Placer County 5, Riverside County 5, Riverside 70, Redlands 1, San Bernardino 2, San Diego County 2, Coronado 9, National City 3, San Diego 18, San Francisco 9, Burlingame 1, San Mateo 1, Lompoc 5, Santa Barbara 1, Santa Clara County 1, Healdsburg 1, Fillmore 2, Santa Paula 2, Ventura 3, Davis 5.

Pneumonia (Lobar)

116 cases: Berkeley 1, Oakland 11, Angels Camp 1, Contra Costa County 1, Fresno 1, Imperial County 4, Westmoreland 1, Kings County 1, Los Angeles County 14, Alhambra 2, Compton 1, Glendale 2, Los Angeles 38, Monrovia 1, San Gabriel 1, Whittier 1, Maywood 1, Madera County 1, Madera 1, Napa County 1, Santa Ana 2, Tustin 1, Placer County 1, Auburn 1, Sacramento County 3, Sacramento 5, San Francisco 7, San Joaquin County 1, San Luis Obispo County 2, Daly City 1, Santa Clara County 1, San Jose 5, Yuba County 1.

Scarlet Fever

229 cases: Alameda 1, Berkeley 3, Oakland 2, Butte County 6, Colusa County 1, Fresno County 7, Fresno 1, Brawley 1, Kern County 4, Lassen County 3, Susanville 3, Los Angeles County 16, Alhambra 2, Burbank 2, Culver City 1, Glendale 3, Huntington Park 1, Inglewood 1, Long Beach 5, Los Angeles 20, Pasadena 4, Pomona 1, Redondo 1, San Fernando 1, Santa Monica 2, Hawthorne 1, South Gate 2, Maywood 1, Madera County 1, Mill Valley 4, San Rafael 1, Mariposa County 2, Merced County 7, Merced 1, Modoc County 7, Pacific Grove 1, Napa County 4, Placer County 9, Auburn 2, Roseville 1, Riverside County 3, Riverside 1, Sacramento County 2, Sacramento 10, Redlands 1, San Bernardino 1, San Diego 3, San Francisco 13, San Joaquin County 2, Stockton 1, Paso Robles 1, San Mateo County 1, South San Francisco 1, Santa Barbara County 1, Lompoc 2, Santa Barbara 1, Santa Clara County 1, Palo Alto 4, San Jose 5, Santa Cruz 2, Shasta County 3, Vacaville 1, Vallejo 1, Healdsburg 3, Santa Rosa 1, Stanislaus County 5, Tehama County 1, Tulare County 4, Lindsay 2, Tuolumne County 4, Sonora 1, Ventura County 5, Ventura 4, Davis 1, Marysville 1.

Smallpox

5 cases: Burbank 2, Los Angeles 1, Modoc County 1, Lodi 1.

Typhoid Fever

16 cases: Oakland 1, Fresno County 3, Fresno 1, Los Angeles County 1, Inglewood 1, Whittier 1, Merced County 1, Orange County 1, San Francisco 1, Tulare County 5.

Whooping Cough

137 cases: Alameda 3, Oakland 3, San Leandro 1, Martinez 2, Fresno County 2, Los Angeles County 13, Glendale 4, Huntington Park 2, Long Beach 1, Los Angeles 46, Montebello 1, Pasadena 1, San Fernando 1, Santa Monica 3, Whittier 5, Merced County 5, Orange County 1, Anaheim 3, Santa Ana 1, Riverside County 4, Riverside 3, San Bernardino 2, San Diego County 3, San Diego 5, San Francisco 5, San Joaquin County 2, San Luis Obispo County 1, Santa Barbara County 1, Santa Barbara 6, Santa Maria 1, Palo Alto 1, Tulare County 2, Tulare 1, Ventura County 2.

Meningitis (Epidemic)

5 cases: Los Angeles.

Dysentery (Amoebic)

3 cases: San Diego County 1, San Francisco 1, Los Gatos 1.

Dysentery (Bacillary)

One case: Los Angeles.

Ophthalmia Neonatorum

2 cases: San Francisco 1, South San Francisco 1.

Pellagra

One case: Oakland.

Poliomyelitis

4 cases: Berkeley 1, Fresno 1, Los Angeles 1, Madera County 1.

Tetanus

One case: Paso Robles.

Trachoma

One case: Riverside County.

Jaundice (Epidemic)

One case: Oakland.

Food Poisoning

30 cases: Alameda County 1, Berkeley 3, San Francisco 26.

Undulant Fever

One case: San Bernardino.

Coccidioidal Granuloma

One case: Fresno County.

Septic Sore Throat (Epidemic)

One case: San Francisco.

Rabies (Animal)

20 cases: Los Angeles County 7, Culver City 1, Glendale 3, Inglewood 1, Long Beach 1, Los Angeles 6, La Mesa 1.

It has been said that the foundation of health is proper feeding. In its broader aspect the proper feeding of children revolves around the public recognition of the dependence of humans upon the dairy cow. The white race cannot survive without dairy products.

—Health Digest.

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